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ABSTRACT

A theoretical position that mind is not separate from the ways in which it is evidenced through the body is in contrast with an assumption made in the literature on children's theory of mind that maintains that mental states can only be demonstrated independently of their behavioral context. This assumption is tested by the false belief criterion, which supposedly studies mental motives, and which closely resembles some of Piaget's tests of object permanence. In an effort to test infants' understanding of others' minds, a series of studies of babies' comprehension and production of referential behaviors was carried out. Results suggested that three mechanisms underlie mothers' and infants' joint visual attention. The ecological mechanism involves the infant's ability to understand the mother's orienting behaviors; the geometric mechanism involves the infant's ability to pick out the direction and location of an object referred to by the mother; and the representational mechanism, which is evident after 18 months of age, involves infants' attempts to look in hidden locations. These results suggested that mechanisms of attention and perception in infancy presuppose object permanence. A list of 12 references is provided. (BC)

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# Towards an ecology of mind

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## Introduction

I have called this paper 'Towards an ecology of mind' after the title of a book by the anthropologist Gregory Bateson (1972). In this collection of essays Bateson argues that a full understanding of the properties of mind is only to be obtained in relation to the social and ecological structures in which it is immanent. He maintains that it is a fundamental epistemological error to separate the mind from the ways in which it is evidenced through the body, in human relationships, in society and in the ecosystem.

This theoretical position stands in stark contrast with one of the main methodological assumptions that has been made in the recent literature on the child's 'theory of mind'. Here it has been argued that an understanding of mental states can only satisfactorily be demonstrated independently of its behavioural and ecological context. The 'false belief' criterion was first suggested as a means of discovering whether chimpanzees impute mental states to others by Premack and Woodruff (1978). This test supposedly gets at specifically mental motives by making the assumption, which itself is possibly a false belief, that mental events are not directly observable in behaviour. Evidence that the chimpanzee or child is imputing a false belief to another enables the investigator to be sure that the understanding of motives is not based on behavioural cues but on the imputation of a mental state to the other.

The false belief task is a test of the child's understanding of the knowledge possessed by another observer of the visible and invisible movements of an object. An

example can be taken from Wimmer and Perner's (1983) paradigm, in which the young child is told a story, using props, about a child called Maxi. Maxi helps his mother unpack the shopping and places a bar of chocolate in a green cupboard being careful to remember where he stored it, so that he can come back later and eat some. He then goes off to play. His mother then uses some of the chocolate in cooking and places the remainder in another, blue, cupboard. The child is asked where Maxi will search for the chocolate. Children of 4 years say that he will look for it in the blue cupboard, where it was most recently hidden, even though Maxi could not know this. By 5 years, the child says Maxi will look for it in the green cupboard, where he last saw it, thus revealing knowledge of Maxi's false belief. The younger child bases her assessment of Maxi's knowledge on her own perception of the visible movements of the object whereas the older child takes into account that the displacement of the chocolate from the green to the blue cupboard was not visible to Maxi. The task assesses knowledge based on differentially available perceptual evidence.

Let us take a closer look at the task demands of the false belief test. The child's comprehension of false belief is inferred from the pattern of search within a represented reality. It is striking that the task resembles very closely a series of physical search tasks devised by Piaget for assessing a baby's understanding of object permanence. In fact, Piaget might have argued that the failure of four year olds and the success of five year olds on false belief tasks demonstrates a 'vertical decalage' between the achievements of

stages IV, V and VI of the sensori-motor stage in object permanence, where the child masters the visible and invisible movements of an object in manual search tasks and the later part of the preoperational stage. If this analysis of the structure of the false belief task is accurate, then it may be informative to examine its precursors in infant development.

## Relation of the false belief task to Piaget's Sensorimotor stage

I don't mean to say that infants have beliefs or that they impute beliefs to others. Rather, in the absence of beliefs, false or otherwise, does the behaviour of infants give us any leverage on the problem of knowing other minds? Straight away we come up against a fundamental disagreement between constructivist theories such as Piaget's, and ecological theories such as those of Michotte, Gibson and Bower.

On the basis of manual search tasks, Piaget described a progressive series of stages, beginning at about 9 months, when the baby becomes able to search manually for an object hidden under a cloth, followed by mastery of visible movements of the object at about 12 months and culminating at about 18 months when the baby will search persistently for a hidden object after visible displacements. This sequence is said to reveal the infant's progressive construction of a concept of object permanence and identity.

This general sequence of substages has been broadly replicated in much infant research but there has been a great deal of debate about whether the tasks truly reveal what the infant understands about object permanence or whether they

merely reveal a hierarchy of difficulty in tasks that depend on the sequential organisation of goal directed manual behaviour. Piaget's tasks may reveal a failure to reason with respect to object permanence and identity but they do not necessarily demonstrate a failure to understand. Piaget's tasks however, were set in a 'cold-blooded' experimental context and the implications for the infant's understanding of mind were not explored. In fact, the Piagetian assumption of absolute egocentrism would seem to preclude any understanding of other minds in infancy.

Perhaps one way forward with this question may be to do what Bateson suggests, and set the search tasks in a real world context of human relationships to see what this reveals.

Research on joint visual attention

Scaife and Bruner (1975) were the first to show that infants as young as two months would reorient their gaze contingent upon a change in the focus of visual attention of an adult. The signalling function of joint visual attention has since been extensively studied in my own laboratories and we have reported some of this work in various publications (eg Butterworth 1987, 1990; Butterworth and Cochran 1980; Butterworth and Grover 1988; Butterworth and Jarret 1991). I will not go into all the details of these studies again. Rather, I will simply draw attention to the main findings that have implications for the infant's understanding of other minds.

**Main results**

Over the years we have carried out an extensive series of studies of how a baby understands where someone else is looking, how they understand where someone else is pointing, and most recently on how they produce manual pointing for others. These experiments are all concerned with the comprehension and production of referential behaviours, ie behaviours which single out an object for the attention of an other, so that experience may be shared. As Scaife and Bruner (1975) pointed out, the fact that a baby will look where someone else is looking implies that she must be less than totally egocentric.

Our main findings, consistently obtained over many studies, suggest that three mechanisms underlie joint visual attention in infancy: these we call the ecological, geometric and representational mechanisms. An important discovery was that the capacity for joint visual attention is limited by the boundaries of the infant's visual field. That is, babies will search within their own visual space for a possible object of the mother's change of attention but rarely search beyond the boundaries of vision. They behave as if their own visual space is held in common with others and we have taken this to be evidence for an objective, Gibsonian theory of visual perception in infancy, as opposed to the Piagetian solipsistic account.

The youngest infants in our studies, at 6 months, perceive the direction in which to look, to left or right on the basis of the mother's change of visual orientation but they cannot identify which of two targets on the same side of

the room the mother is looking at. However, if an ecologically relevant clue is added to the object, so that it singles itself out, infants will invariably find the correct target. For example, if one of the targets is set in motion, contingent on the mother's signal, then the baby will pick that target out when she sees the mother turn. The baby, long before she can search for hidden objects manually, seeks out a possible object of the mother's attention, and this search is completed when a suitable object is encountered in the ecology. No mind reading is involved. Rather, a meeting of unrelated minds occurs in an object of common experience. From the infant's point of view, there is no world of the mental separate from its expression in the orienting behaviours of the mother, which single out publicly perceivable objects for joint attention.

By twelve months, we have evidence for the beginning of a new 'geometric' mechanism which enables the infant to single out the correct target, even when the targets are identical in all respects save their location. That is, the baby from her position can pick out both the direction and the location to which the mother is referring in their shared visual space. Babies are extremely accurate in locating which of two identical targets the mother is pointing at (Butterworth 1991).

This new geometric ability seems coincident in development with the comprehension of manual pointing and it also seems to be implicated in the infant's own production of pointing for others.

The advent of the geometric mechanism actually is compatible with Piaget's description of the stage V baby who begins to comprehend the invisible displacements of objects. The infant, from her position extrapolates an invisible trajectory from the pointing hand into visual space to its intersection with an object. At 14 months, babies check after pointing, to establish whether the object they have singled out is the one being attended to by the mother, which also reveals a concern for communication. But again, there is no need to impute to the baby knowledge of mental states independently of their bodily and ecological accompaniments. By about 16 months babies show the beginning of a metacognitive understanding of pointing and they will check to establish whether the adult is attending to them before they point (Franco and Butterworth 1990). This might be taken as evidence for an early understanding of mental states but in the context of the series of experiments as a whole, it might more appropriately be taken as further evidence that knowledge of other minds resides in the expressive behaviours of other bodies, with respect to publicly observable objects.

At 18 months but not before, babies begin to search behind them for objects when the mother singles out these hidden locations. We call this new mechanism representational because the infant begins to behave as if the mother's looking and pointing signals refers to objects contained within a space that lies beyond the joint visual field. That is, a space beyond the confines of immediate perception begins to be accessed as a possible meeting place for the infant's and the adult's minds. This ability is only revealed when the visual

field is emptied completely of potentially interesting objects, as if a representation is available but subordinated to the perceived field of view.

The implication is that these mechanisms, in the normal ecology, would work in mutual support of each other, in the service of definite reference. It is only in the laboratory that we can reveal, through the developmental method, and by stripping the tasks down, the new mechanisms that become available with development. That is, successive stages do not replace each other - they add new capacities to a core capacity.

## Conclusion

In conclusion, our experiments reveal the elaboration of mechanisms which enable a meeting of minds and communication between infants and adults in relation to publicly observed objects. The evidence suggests that mechanisms of attention and perception in infancy presuppose object permanence, as Michotte and Gibson argued, rather than that infants construct the object through action, as Piaget supposed. The infant behaves from the outset as if the adult's behaviour signals the permanent possibility of an object in the real world.

It is the real world and its objects which links the participants in the interaction, this is what their minds hold in common. As William James (1912) and Hobson (1991) have argued, the origins of information about other minds lies in person perception; the baby does not simply perceive behaviour and then later impute mental states; nor do we as adults perceive disembodied minds. My own research on the mechanisms

underlying proto-communicative competence is consistent with the view that body-mind relation is perceived directly. The baby is not constructing a theory about the object at the source of the adult's visual attention, nor is she constructing a theory about a mental state of visual attention underlying orienting movements. A change of direction of gaze simply signals the permanent possibility of an object, somewhere in shared visual space.

But, while I believe this ecological analysis to be correct for infants, there may be other factors that need to be taken into account in linking the behaviour of young children in false belief tasks to the data on proto-communication in infancy. Bateson (1972a) discussed what he called 'the mysterious step from the iconic to the verbal' in describing the difference between the signalling systems of animals and men.

Joint visual attention and pointing are iconic systems of communication: the subject of any predicate is always present, because he or she is the emitter of the signal. Furthermore, the social interactions on which communication is based are necessarily positive. That is, joint visual attention and pointing signal the <u>presence</u> of an object potentially available to another observer. There is no simple, iconic way of making reference to a negative or non-existent object at a particular place.

The false belief task requires the child to reason about what Maxi did not see while holding in mind their own iconically based knowledge of the true location of the object. It seems possible that children may all along understand true

beliefs as mental events expressed through behaviour, with respect to objects in the normal ecology. However, the false belief task presents them with the additional requirement to reason about negation. The child must reason about places where the object is not, which by definition is an aniconic problem. On this analysis passing the false belief task may not, like some graduation ceremony, reveal the child's first understanding of mental events. It may nevertheless reveal the beginnings of the ability to make use of non-existence of an object in reasoning. Interestingly, intentional non-existence is a criterion that representationalist theories have used for having a mental life. The implication is that reasoning about intentional non-existence may depend on aniconic, symbolic coding and this may not be possible within an iconically based representation.

It follows then that the ability to solve false belief tasks, which theorists such as Josef Perner (1991) have taken as criteria for acquiring a theory of mind, may actually reveal a new level of coordination between iconic and aniconic systems of representation. Further debate about children's understanding of mental life might fruitfully begin with an analysis of how non-existence of objects may be represented by young children, since this may well lie at the roots of the child's difficulties with the false belief task. Such a fine grained analysis would enable us to reunite research on reasoning about mental events with the ecological tradition which rightly insists that minds are embodied and in the world.

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